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IN THE EASTERN UNITED STATES:  
A STUDY OF PHYSIOGRAPHIC PROVINCES**

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Paper to be published in a Special Volume on Site Formation, edited by K. Paddayya,  
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# **TACKLING SITE FORMATION ON PREHISTORIC SITES IN THE EASTERN UNITED STATES: A STUDY OF PHYSIOGRAPHIC PROVINCES**

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## **INTRODUCTION**

Site formation, or the multiple factors which have created the archaeological record we view today, is a matter of fundamental importance in archaeological inquiry. The formation of a deposit is the consequence of behavior and an array of depositional and postdepositional processes. Michael Schiffer (1972, 1976, 1987) has conducted pioneering research on the topic of formation processes, explicitly drawing a distinction between systemic and archaeological contexts. In Schiffer's model, artifacts and facilities are used in various ways during their life history. Once items fall out and no longer participate in the systemic context, they end up in archaeological context. The reconstruction of human behavior is drawn from the archaeological context, or the three dimensional spatial patterning of artifacts, features and other debris. Three stages can be conceived in which material remains become incorporated into the archaeological record (Gifford 1978). The first stage is site occupation, where human behavior leads to the creation of cultural patterns. This may consist of single or multiple activities of variable intensity and duration, and it may involve one or more occupations on the same surface. At the time a site is occupied and until it is recovered by archaeologists, material remains become incorporated into the deposit. Depending on depositional context and processes, occupations may always remain on the surface or they may become slowly or quickly

buried. A variety of postdepositional processes, including geological, chemical, and biological agents, may selectively preserve and pattern cultural materials (Wood and Johnson 1978; Butzer 1982; Stein and Farrand 1985; Nash and Petraglia 1987; Waters 1992; Holliday 1992; Goldberg et al. 1993; Rapp 1998). From this record, archaeologists excavate a sample of the site, and recover materials in context. It is anticipated that behavior is organized (Binford 1981, 1982) and combinations of natural and cultural processes will result in regular and predictable residues (Schiffer 1976, 1983). As a result, archaeological patterns and their spatial arrangements are expected to be closely tied with specific activities and environmental and geomorphological contexts. Although archaeologists should expect regularized patterning, this is not to deny that the patterning can be quite complicated, and perhaps non-linear and chaotic; thus, the result of nuances of activity and local environmental conditions (Petraglia 2000). Accurately determining behavior in these circumstances rests on the ability of the analyst to recognize contextual diversity and the specific cultural and natural processes which led to the creation of the stratigraphic record and its spatial arrangements.

The goal of this article is to examine the formation of prehistoric sites located in the Mid-Atlantic region of the Eastern United States. While theoretical orientations on site formation are important, with major insights gained from ethnoarchaeology and experiments, it is also important to consider how archaeologists may be able to apply this knowledge and infer various natural and cultural processes from the archaeological record.

Thus, this article is written for archaeologists working in India in order to familiarize researchers with realistic problems and issues that are presented in dealing with an archaeological record in a different context. It is hoped that aspects of this site formation research will provide some degree of guidance to Indian archaeology, although it is fully recognized that great strides are being made in geoarchaeological and site formation research in Peninsular India (e.g., Paddayya 1987; Paddayya and Petraglia 1993, 1995; Petraglia 1995a; Jhaldiyal 1997, 1998; Pappu 1996, 1999; Khrisat 1999).

## **SITE FORMATION RESEARCH IN THE REGION**

Before assessing formation processes on the particular sites under analysis, the degree to which archaeologists have paid attention to site formation in the Mid-Atlantic should be reviewed. To obtain an impression of how much research is expended on site formation, two major regional journals were systematically reviewed (Petraglia and Knepper 1996a). Issues of the *Archaeology of Eastern North America* and the *Journal of Middle Atlantic Archaeology* were surveyed for articles concentrating on site formation. Articles were examined to ascertain if they centered on geomorphology, geoarchaeology or the ways in which spatial patterns of the archaeological record were analyzed or formed. Notation of articles which systematically addressed these issues were tabulated, and not those which simply mention the topic of site formation or site formation analyses. For the *Archaeology of Eastern North America* from 1982 to 1999 and the *Journal of Middle Atlantic Archaeology* beginning in 1985 to 1998 there were a total of

278 articles. A total of 17 (6%) articles contained material directly assessing site formation.

Of the 17 articles which discuss site formation, the most common aspect of formation analysis addressed is artifact refitting, used to establish stratigraphic or depositional integrity. A larger number of articles do mention site formation, indicating an awareness of the issue, but often the issue is not dealt with in the analysis. There are several treatments of geomorphology and sediment analysis as it applies to deposition and preservation. There are specific case studies on the mechanics of artifact movements in soil profiles and on the depositional and postdepositional ramifications of insect remains in burials. In several articles, there are general statements on the effects of scavenging, pit feature formation, postdepositional artifact displacement, and faunal bias preservation.

For the most part, treatments of stratigraphy, site structure, and geomorphology are descriptive and often mechanical and perfunctory, with little or no consideration of their development or their interrelationships. Geomorphological data are often used to assess environmental associations, controlling for site formation and preservation factors. It would probably not be surprising to find that most archaeologists assume that they are cognizant of site formation and pay attention to site formation processes as a matter of course. However, while awareness of context is desirable, the analytical approach to site formation needs to be explicit. There is much more to site formation analysis than simply

indicating that a stratigraphic deposit is intact or pointing out that rodent burrows and disturbances are present.

## **A STUDY OF FORMATION PROCESSES IN THE MID-ATLANTIC REGION**

The Mid-Atlantic region of the Eastern United States has a prehistoric record that ranges from the Paleo-Indian Period to European Contact, with major differences and changes recorded over this 11,000 year period (Custer 1989; Dent 1995). As the prior review of the major regional journals indicated, prehistoric sites have not been subject to much systematic site formation work. Given that there are major contrasts in the physiographic provinces of the Mid-Atlantic, it has been posited that these zones may be a potentially useful way to characterize and examine site formation. These zones consist of the Appalachian Plateau, the Ridge and Valley, the Piedmont and the Coastal Plain, each varying with respect to climatic factors and edaphic factors, such as slope, soils, surface water and exposure. Archaeologists have explicitly and implicitly embraced the physiographic models of landscape and environmental variability to understand prehistoric subsistence strategies, settlement patterns, and technology. For instance, Gardner's (1987) idealized transects for settlement pattern studies across physiographic zones of the Mid-Atlantic are perhaps the best known regional examples of this practice. Thus, a similar approach is adopted here for assessing site formation as an organizing principle. It should be anticipated that each physiographic province will provide its own gross site formation characteristics, although each site will have different functional activities and

chronological histories. It is also the case that each province will be cross cut by geomorphological zones, such as hillcrests, slopes, floodplains, and terraces. Thus, since prehistoric sites in the Mid-Atlantic region are located in specific physiographic zones and depositional contexts, it is anticipated that they should generally exhibit particular archaeological patterns and site formation characteristics that may be investigated through various methods.

Five archaeological sites are examined in three major physiographic zones, two in the Appalachian Plateau (Kettle Creek and Connoquenessing sites in Pennsylvania), two in the Piedmont (Cedar Run and Cedar Creek sites in Virginia), and one in the Coastal Plain (Lums Pond site in Delaware). These sites were chosen since they have undergone extensive excavation and analysis and they are considered to be representative of a class of sites in each of these regions. Within each province, the relationship between geomorphology, soils, and the vertical and horizontal distributions of artifacts and features are examined. To place as many controls as possible on this study, sites of certain ages and types were selected allowing for better comparison of site formation. In the selected cases, sites were chosen that were primarily Late Archaic in affiliation, dating to from approximately 3000 to 500 B.C. Selection of sites ranging over a restricted time period and a temporal range of 2,500 years, is assumed to produce a consistent set of limits in the range of environmental processes acting on the sites. In further placing constraints on the possible array of formation processes, each of the sites chosen is an example of a relatively

short term, special activity or specialized procurement site, as opposed to a continually occupied, sedentary village locale.

Two sites were chosen from the Unglaciaded Appalachian Plateau of Pennsylvania, the Kettle Creek site (Petraglia et al. 1996) and the Connoquenessing site (Knepper and Petraglia 1996b). The Appalachian Plateau is characterized by relatively flat lying strata which are broken only by small faults and low, broad folds. The topography ranges from deep-sided, narrow stream valleys to uniform low, rolling hills. There is a dendritic drainage pattern corresponding to the dissected plateau surface. The area is wet and cool with humid oak-chestnut forests. The soils are generally acidic and on floodplains they are generally unconsolidated, heterogeneous mixture of recently deposited clay, silt and gravel from reworked Pleistocene gravels from glacial outwash.

The Kettle Creek site lays at a similar elevation as the Connoquenessing site, approximately 872 feet above mean sea level. The site is located on the floodplain of Kettle Creek, a perennial stream flowing through a dissected valley toward the West Branch of the Susquehanna River. Late Archaic period occupations were identified on the western and eastern sides of the stream. On the west side, alluvial aggradation of silts and sands produced deep and stratified cultural deposition (Figure 1). Extensive and well-developed soil horizons were present within the profile. Stratigraphic separations and radiocarbon dates established several reoccupations during the Late Archaic. Late



Archaic occupation consisted of an intact surface with high artifact density and spatial distributions indicative of human activity. One soil horizon contained scattered heated rocks and artifacts. While sediment aggradation led to preservation of cultural levels, there were stratigraphic signs for overprinting of Late Archaic occupations and postdepositional vertical transformation as indicated by artifact density and refits. The remnant and scattered fire cracked rock features may represent disassembled hearths from postdepositional disturbances. The loss of organics in this situation may also signal postoccupational deteriorations. On the east side of Kettle Creek, the valley was broad and wide (see Figure 1). An initial phase of Late Archaic occupation was followed by lateral stream migration, producing cut and fill sequences, and new sediment aggradation in places. As a result, cultural stratification was horizontal, with Late Archaic period material below the shallow sediment mantle, or the plowzone. High ground resulting from sedimentation in one place contained artifacts and a series of shallow and highly organic pit features (Figure 2). Multiple reoccupations in this area during the Late Archaic was evident by spatial distributions and the temporal range of radiocarbon dates. While features could be discerned, repeated occupations in the same area tended to produce spatial overlap among features and a dense accumulation of surrounding anthropogenic material which could not be separated by particular occupation.

The Connoquenessing site is at an elevation of 868 feet above mean sea level on a low terrace above Connoquenessing Creek. The perennial creek is a tributary of the

Beaver River, which drains into the Ohio River. The site is situated in a relatively wide valley with broad, gently sloping terraces. The terrace consists of a thin mantle of Holocene alluvium overlying Pleistocene age alluvial sediments, thus sediment aggradation was minimal. Cultural stratigraphy was limited to the plow-zone surface layer. Artifacts in the plow zone were few, with a mean count of 10 artifacts per one meter unit. As a result, there was no spatial clustering of artifacts. There were few features, and of the ones that survived, these consisted of pits that penetrated the sterile subsoil. The Late Archaic features consisted of pits with in situ burning overlain by fill, and basin shaped pits containing fill resulting from refuse disposal or post abandonment processes. The relative similarity in size and depth of the basin features suggested that the original ground surface had not varied significantly during the site occupation (Figure 3). The overall density and distribution of artifacts and features suggested the probability of multiple, relatively closely spaced, but non-intensive occupations. Given that occupations occurred on the same surface, with little sediment aggradation, the potential was good for the merging of discrete artifact patterns from separate occupations.

Two sites are located in the northern Virginia Piedmont, the Cedar Run site and the Cedar Creek site (Petraglia and Knepper 1996b). The Piedmont is characterized by low relief and rolling, hilly plains. Most of the surface water occurs as low order drainages which have small floodplain swamps and bogs. The Northern Virginia Piedmont drainages empty into the Potomac River, the major regional drainage. The surface soil in

this zone is the result of weathering of sedimentary rocks. Residual alluvial gravel deposits are common throughout the area. The region is characterized by an oak-hickory-chestnut forest cover.

The Cedar Run site is situated at about 200 feet above mean sea level. The site sits on an upland ridge above Cedar Run, a perennial stream flowing through a dissected valley. Sedimentation from overbanking of Cedar Run was not possible in this elevated context, the sediments composed of weathered bedrock residuum and contributions by a combination of processes including sheetwash from higher ridges and aeolian and colluvial processes. Cultural deposition in this context was shallow, confined to the plow zone. The number and variety of Late Archaic projectile points and artifacts implied multiple reoccupations over a large area. The shallowness of the deposits and the proximity of bedrock was not conducive for feature preservation. No patterning in the horizontal and vertical distribution of artifacts was viewed in this context.

The Cedar Creek site lay at an elevation of approximately 195 feet above mean sea level. Evidence of Late Archaic occupation occurred on a terrace adjacent to the creek, which is a low order, spring fed stream. Like the Cedar Run site, in most places, bedrock was close to the surface, thus artifacts were contained in shallow deposits. In other places, bedrock was deeper, allowing for stratigraphic development. Cultural deposits reached up to 1 meter, the result of colluvial and sheetwash processes from more elevated

contexts and alluvial deposition from Cedar Creek. The profile was mainly made up of a silt loam, containing weakly developed or incipient soils. The deposit was visually undifferentiated with no laminations or other variations in soil color or texture. Artifact counts and density was high throughout the profile. Concentrations of fire cracked rock were identified, although no charcoal or darkened or reddened soil was encountered. The large amount of artifactual material and the wide range of artifacts and projectile points suggested extensive or repeated site use. Integrity of the profile was established by the presence of the features and the general chronological ordering of projectile points through the vertical profile. However, the effects of slow burial rates between Late Archaic occupations and postdepositional disturbances were also apparent. The vertical range of projectile points was mixed somewhat, indicating that no individual temporal components could be isolated. The general horizontal artifact distribution indicted the presence of clusters of material, remnants of activity areas. While these remnant areas could be identified, no contemporaneity could be proven, and blending of artifact distributions in the same level may be a sign of cultural or natural overprinting. The blending of the sediment profile and some sorting of artifacts vertically indicated that postdepositional processes acted on the site, probably biological agents as evidenced by root casts and worm and insect burrowing. However, these postdepositional transformations were not great enough to alter all vertical and horizontal patterns or move larger clasts, as demonstrated by feature integrity. The lack of organics in the levels and features may signal chemical deterioration and blending of soils by natural agents.

The Lums Pond site lies in the High Coastal Plain of Delaware (Petraglia et al. 1998). The Coastal Plain is characterized by low and level relief, made up of Pleistocene sands and gravels, with considerable expanses of poorly drained swamps and marshes along streams, with well drained soils along their terraces and floodplains. The Lums Pond site is at an elevation of 50 to 75 feet above mean sea level along the upper and lower terraces of a low order stream that flows to St. Georges Creek, which in turn, flows into the Chesapeake Bay. Late Archaic occupations occurred on two separate landforms, a sloping terrace above the stream and on the floodplain itself. Upper terrace areas consisted of plow-disturbed silt loam or recent aeolian sediments overlying undisturbed sandy Pleistocene outwash deposits. In this context, most artifact patterns were blended as a result of low natural sediment aggradation and erosion, and repeated activity in one location. Although most patterning was blended, these deposits indicated that some activity areas, such as lithic reduction areas, were preserved as a consequence of singular activity and lack of repeated deposition of cultural material (Figure 4). A series of pits were excavated into the sandy subsoils (Figure 5). The pits contained organics and artifacts, together with tightly clustered radiocarbon dates. The non overlapping pits, their tight absolute dates, and their consistent material patterning indicated short term use and relatively rapid infilling. The sandy substrate also preserved enigmatic features, which also contained occasional artifacts and charcoal flecking, the result of some combination of natural and cultural processes. A second part of the site was situated on the floodplain of

the creek where stratified deposits up to a meter in depth were recovered. The sediments were derived from overbank flooding, consisting of silt loam deposit, with soil development and a highly organic layer. The levels contained a moderate number and density of artifacts, some of which refit (Figure 6). In one level, a disassembled hearth was evident in spatial clustering and its refits (Figure 7). While cultural and depositional patterning in this level could be identified, postdepositional processes were also recorded. Refitting indicated vertical transformations of artifacts by postdepositional processes by as much as 20 cms upwards and downwards, although there was size-sorting by artifact type (Figure 8). The stratigraphically was ordered, but temporally divergent radiocarbon results confirmed the potential for mixing as well.

## **DISCUSSION**

Provided this brief background on the sites, the relationship between site formation and physiographic province may be examined. An interesting comparison can be made between the archaeological deposits on upland contexts of the three provinces. In general, the site-wide comparison indicates that the Appalachian Plateau and the northern Virginia Piedmont generally exhibit shallower stratigraphies. The Connoquenessing site in the Appalachian Plateau and the Cedar Run site in the Piedmont, tend to be characterized by shallow stratigraphies with slower rates of deposition over erosion. In this situation, soils do not easily develop and repeated occupation would occur on a thin sediment matrix. Given repeated occupations in these areas, archaeological patterns would thus be

overlapping and discrete activities would be difficult to establish from artifact distributions. A main difference between the two contexts was in their substrates, resulting in variable feature preservation. In the Appalachian Plateau context, feature preservation was possible as a result of an unconsolidated subsoil matrix that allowed the excavation of hearths at the Connoquenessing site. In contrast, at the Cedar Run site, bedrock was at or near the surface, resulting in little possibility for preservation of features. In another site example in the northern Virginia Piedmont where extensive refitting occurred, it was found that discrete reduction activities and space use could be discerned from such shallow contexts (Petraglia 1995b).

Generally, the upland situation on the Coastal Plain appeared to contain more deposition over erosion, allowing for the development of soils. Archaeological patterns there may indicate single activities or activity sets from one occupation. However, since deposition was not very rapid, repeated occupation of the same surface also occurred, resulting in mixed assemblages from re-occupations. In the Coastal Plain, sediments often consist of sandy substrates, thus allowing for the excavation of pits. Organics survived in this case because of evidence for fairly rapid infilling. However, in other situations, organics may not survive, either due to destruction as a result of slow burial or water filtration through the sandy sediments. In such a sandy matrix, preservation of disturbances caused by non-anthropogenic agents would also be expected, leading to queries about the natural or cultural origin of certain features.

Comparison of lowland or floodplain situations in the three physiographic provinces likewise indicates variability with regard to site formation. The floodplains and low terraces of streams in the Appalachian Plateau, the Piedmont, and the Coastal Plain all contained stratigraphic deposits. At Kettle Creek West, the Cedar Creek site, and the Lums Pond site, soil development was present, with definable artifact distributions associated with Late Archaic surfaces. Thus alluvial deposition sealed artifacts and features both as “structural” (i.e., obvious form identifiable in the field) and “latent” (i.e., found through computer plotting for example) patterns and features (Leroi-Gourhan 1972; Petraglia and Knepper 2000). While Late Archaic surfaces were buried, there was evidence for some degree of overprinting and postdepositional processes, although the magnitude of these processes was greatest in the Piedmont situation. In Kettle Creek West and the Lums Pond site, organic soil horizons, features, and artifact patterning were recognizable, but there was evidence that the cultural levels may represent accumulations of separate occupations or merged activity sets during one occupation. In addition, stratigraphic evidence indicated that there was movement of material through levels, thus causing some alterations in artifact patterns. The Cedar Creek site also contained a definable, but diffuse Late Archaic horizon. However, postdepositional processes had homogenized the stratigraphic profile, destroying evidence of soils, organic horizons, and organics associated with features. In the Appalachian Plateau region, where floodplains tend to be wide and stream courses meandering, there was also evidence for little sediment



deposition, with instances of erosion and site destruction. Little sediment accumulation was apparent on the wide floodplain of the Connoquenessing site, especially as distance increased away from the river channel. Geoarchaeological work indicated that site alteration was especially apparent in the Kettle Creek East site where stream erosion led to destruction of archaeological deposits. In addition, geoarchaeological investigations at Kettle Creek and at Lums Pond also indicated the variable preservation environments at both sites, with phases of erosion and deposition.

## **CONCLUSION**

This article has attempted to make a case for paying explicit attention to the formation of the archaeological record, using a small but comprehensive data set from the Middle Atlantic region of the Eastern United States as a case example. It is hoped that this study shows that archaeologists must make a concerted and explicit effort to examine the role of cultural and natural processes in forming the archaeological patterns that they are attempting to interpret. In this study, site formation has been examined from the perspective of the variable preservation conditions in three physiographic provinces, showing that formation processes are generally related to the particular geomorphic circumstances in each province. The rate of deposition and the intensity of cultural occupations is found to influence the organization of site patterning. These factors may be predicted from prior knowledge of the geomorphological conditions present, affording an initial assessment of site integrity and providing preliminary guidelines for subsequent

analyses. This type of analysis needs to be more coherently formalized, and explicitly carried out as the first step in any archaeological investigation. Site formation studies should be seen as a necessary and fundamental element in an examination of any particular element in archaeological analysis. In published articles and in many archaeological projects, there are instances where formation issues are addressed. However, the issues are not part of a comprehensive research design, informing the rest of the analyses and interpretations. Thus, site formation analysis is important at all levels of the study of prehistory, whether in choosing predictive survey models, in site significance evaluation, or in data recovery sampling. Hopefully, archaeologists will integrate site formation studies in their research designs in the future, informing the analyst about the processes leading to observed spatial configurations and preservation conditions.

### **Acknowledgements**

The site excavations and research presented in this article stem from Cultural Resource Management work conducted on behalf of the CNG Transmission Corporation, and the Delaware Department of Transportation. Much of my work in the Mid-Atlantic could not have been accomplished without the capable assistance and helpful advice of Dennis Knepper. Dr. Joseph Schuldenrein offered valuable insights into the geoarchaeology of Kettle Creek and Lums Pond. I thank Dr. Paddayya of Deccan College for asking me to participate in this important volume and for his original invitation to join him in examining the topic of site formation in India.

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## LIST OF FIGURES

Figure 1. Diachronic Model of Landform Evolution at Kettle Creek (after Schuldenrein 1994).

Figure 2. Thermally altered stone feature in basin, Feature 39, Plan View and Profile, Kettle Creek West.

Figure 3. Feature Profiles, Connoquenessing Site. Shallow basins are the most common followed by deeper basins.

Figure 4. Artifact Concentrations in Upland Area of Lums Pond.

Figure 5. Pit Features and Fire-Cracked Rock Clusters in Upland Area of Lums Pond.

Figure 6. Artifact Clusters and Refits, Lower Area of Lums Pond.

Figure 7. Fire-Cracked Rock Clusters and Refits, Lower Area of Lums Pond.

Figure 8. Size-Sorting of Cores/Flake Refits (A) versus Fire-Cracked Rock Refits (B). Note that the larger fire-cracked rocks tend to be more vertically stable than do cores/flakes.